Response to Restriction Requirement

Applicant also respectfully traverses the restriction requirement set forth in the Office Action dated November 6, 2002.

In the Office Action, the Examiner sets forth a restriction requirement between two groups of claims. Group I, claims 1-9, is drawn to a linear motor structure, and is classified in class 310, subclass 12; and Group II, claim 10, is drawn to a method of making a linear motor structure, and is classified in class 29, subclass 596.

The Examiner contends that the inventions of Groups I and II are related as process of making and product made, and have acquired a separate status in the art as shown by their different classification such that the searches are not coextensive, requiring separate examination. These contentions are respectfully traversed.

Applicant notes that the inventions of Groups I and II are so closely related in the field of linear motors that a proper search of any of the claims would, of necessity, require a search of the others. Thus, it is submitted that all of the claims can be searched simultaneously, and that a duplicative search, with possibly inconsistent results, may occur if the restriction requirement is maintained.

Applicant further submits that any nominal burden placed upon the Examiner to search an additional subclass or two, necessary to determine the art relevant to Applicant's overall invention, is significantly outweighed by the public interest in not having to obtain and study several separate patents in order to have available all of the issued patent claims covering

Applicant's invention. The alternative is to proceed with the filing of multiple applications, each consisting of generally the same disclosure, and each being subjected to essentially the same search, perhaps by different Examiners on different occasions. This places an unnecessary burden on both the Patent and Trademark Office and on Applicant.

In the interest of economy, for the Office, for the public-at-large and for Applicant, reconsideration and withdrawal of the restriction requirement are requested.

Nevertheless, in order to comply with the requirements of 37 CFR 1.143, Applicant provisionally elects, with traverse, to prosecute the invention of Group I, namely claims 1-9.

<u>Response to Office Action</u>

The specification has been amended to place the application in better form. A new abstract has also been presented in accordance with preferred practice. No new matter has been added by these changes.

Claims 10-19 are presented for consideration. Claims 10, 11, 18 and 19 are independent. Claims 1-9 have been canceled without prejudice or disclaimer. Claims 11-19 have been added to recite additional features of the invention. Support for these claims can be found in the application, as filed. Therefore, no new matter has been added.

Claim 10, withdrawn from consideration as being as being directed to a non-elected invention, has been retained in this application in order to preserver Applicant's rights.

Applicant requests that the Examiner contact his undersigned representative should it be necessary to cancel this claim in order to advance the subject application to issue.

Applicant requests favorable reconsideration and withdrawal of the rejection set forth in the above-noted Office Action.

Claims 1-9 were rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 6,025,658 to Kamata. Applicant submits that this patent does not teach many features of the present invention, as previously recited in claims 1-9. Therefore, this rejection is respectfully traversed. Nevertheless, Applicant submits that claims 11-19, as presented, amplify the distinctions between the present invention and the cited art.

In one aspect of the invention, independent claim 11 recites a linear motor that includes a magnet array, an electromagnetic coil and a yoke. The magnet array has a plurality of first magnets arrayed such that polarization directions thereof are periodically opposite, and a plurality of second magnets arrayed such that polarization directions thereof are periodically opposite and intersect those of the first magnets. The electromagnetic coil is disposed to oppose the magnet array to generate a Lorentz force in cooperation with the magnet array. The yoke is integrated with the coil at a first side opposite to a second side of the coil disposed opposite to the magnet array.

In another aspect of the invention, independent claim 18 recites a stage apparatus that includes a linear motor having those features discussed above with respect to independent claim

11, and a stage driven by the linear motor. Also, the electromagnetic coil is energized to move the electromagnetic coil and the magnet array relative to each other, thereby driving the stage.

In still another aspect of the invention, independent claim 19 recites an exposure apparatus that includes a linear motor having those features discussed above with respect to independent claim 11, and a stage driven by the linear motor. The electromagnetic coil is energized to move the electromagnetic coil and the magnet array relative to each other, thereby positioning at least one of a substrate and a master with a stage apparatus comprising the linear motor.

Applicant submits that the cited art does not teach or suggest such features of the present invention, as recited in independent claims 11, 18 and 19.

The Kamata patent discloses a linear motor in which permanent magnets move relative to a coil, with a plurality of permanent magnets being arranged along the moving direction while rotating their polarity directions ninety degrees each in turn to generate a sine magnetic field. Each permanent magnet has a simple, rectangular parallelepiped shape with two or more coils of a polyphase coil being simultaneously energized. Applicant submits, however, that the integrated structure in the Kamata patent, when used as a movable element, causes the weight of the device to become heavy.

Applicant further submits that the Kamata patent does not teach or suggest the salient features of Applicant's present invention, as recited in independent claims 11, 18 and 19, including at least the arrangement of the magnet array, the electromagnetic coil and the yoke, in

which the electromagnetic coil is disposed to oppose the magnet array to generate a Lorentz force in cooperation with the magnet array, and the yoke is integrated with the coil at a first side opposite to a second side of the coil disposed opposite to the magnet array. (Applicant submits that, with this arrangement, the present invention lightens the weight of the movable element). Applicant submits, therefore, that the Kamata patent does not teach or suggest the salient features of Applicant's present invention, as recited in independent claims 11, 18 and 19.

For the foregoing reasons, Applicant submits that the present invention, as recited in independent claims 11, 18 and 19, is patentably defined over the cited art, whether that art is taken individually or in combination.

Dependent claims 12-17 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in independent claim 11. Further individual consideration of these dependent claims is requested.

Applicant further submits that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the rejection set forth in the above-noted Office Action and an early Notice of Allowance are requested.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,

Steven E. Warner

Attorney for Applicant
Steven E. Warner
Registration No. 33,326

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-3801
Facsimile: (212) 218-2200

SEW/eab

Application No. 10/079,846
Attorney Docket No. 00862.022569

APPENDIX A

IN THE ABSTRACT

[A linear motor (M) has a linear motor movable element (10) made up from a group of permanent magnets (1a - 1d), and a linear motor stator (20) made up from two electromagnetic coils (2a, 2b). The polarization directions of the permanent magnets (1a, 1c) of the linear motor movable element (10) are opposite to each other in a y-axis direction perpendicular to an x-axis direction which is a moving direction. The permanent magnets (1b, 1d) with the same rectangular parallelepiped shape and a polarization direction rotated from each other through 90° are arrayed between the permanent magnets (1a, 1c). An ideal sine wave magnetic field is thus formed.]

-- A linear motor includes a magnet array having a plurality of first magnets arrayed such that polarization directions thereof are periodically opposite, and a plurality of second magnets arrayed such that polarization directions thereof are periodically opposite and intersect those of the first magnets. The linear motor further includes an electromagnetic coil disposed to oppose the magnet array to generate a Lorentz force in cooperation with the magnet array and a yoke

integrated with the coil at a first side opposite to a second side of the coil disposed opposite to the magnet array. --

IN THE SPECIFICATION:

Please substitute the paragraph beginning at page 1, line 7, with the following.

-- The present invention relates to a linear motor suitably used as, e.g., a driving source for a stage apparatus mounted on an exposure apparatus or the like for the manufacture of a semiconductor device or the like, and a stage apparatus, an exposure apparatus, and a device manufacturing method using the same. --

Please substitute the paragraph beginning at page 1, line 15, with the following.

-- Fig. 12 shows the arrangement of the permanent magnets of a linear motor according to one prior art device. Fig. 12 shows only one of two permanent magnet groups opposing each other through a holding member 7. Permanent magnets 110a and 110b alternately arrayed on the holding member 7 have a non-rectangular parallelepiped shape with corners being cut off. The permanent magnets 110a and 110b are arrayed such that their magnetisms (N and S poles) are alternately opposite. Also, the thicknesses and widths of the permanent magnets 110a and 110b are so adjusted as to generate an ideal sine wave magnetic field in a space between opposing yokes and the permanent magnet groups. --

Please substitute the paragraph beginning at page 2, line 1, with the following.

-- According to the above prior art arrangement, to make the sine wave magnetic field [to] generate an ideal sine wave, the thicknesses and widths of the permanent magnets must locally differ. As the entire shape of each magnet is not a simple rectangular parallelepiped, each permanent magnet is difficult to fabricate with high precision, leading to a high cost. This problem has not been solved yet. The obtained magnetic field density is lower than that obtained with a rectangular parallelepiped permanent magnet, and the driving force of the linear motor is accordingly decreased. --

Please substitute the paragraph beginning at page 2, line 26, and ending on page 3, line 9, with the following.

-- In order to achieve the above object, a linear motor according to the present invention comprises first magnets arrayed such that polarization directions thereof are periodically opposite, second magnets arrayed adjacent to the first magnets such that polarization directions thereof are periodically opposite, and an electromagnetic coil opposing the first and second magnets to generate the Lorentz force by at least the first and second magnets, the second magnets [are] being disposed such that the polarization directions thereof intersect those of the first magnets. --

Please substitute the paragraph beginning at page 3, line 21, with the following.

-- Preferably, either on of the first and second magnets, which is disposed at a terminal end, has a volume [smaller] <u>less</u> than those of the other magnets. --

Please substitute the paragraph beginning at page 6, line 12, with the following.

-- Fig. 12 is a partial perspective view showing a linear motor stator according to [a] <u>the</u> prior art. --

Please substitute the paragraph beginning at page 6, line 19, and ending on page 7, line 10, with the following.

-- Fig. 1 shows an embodiment <u>of the invention</u>. In this linear motor M, a first permanent magnet group of first magnets 1a to 1d are arrayed in the x-axis direction and integrally connected on a holding member 7. The first permanent magnet group has the first magnets 1a and 1c arrayed such that their polarization directions are periodically opposite, and the second magnets 1b and 1d arrayed adjacent to the first magnets 1a and 1c such that their polarization directions are periodically opposite. A second permanent magnet group is arrayed on the other side of the holding member 7. A linear motor movable element 10 is thus formed. In the same manner as the first permanent magnet group, the second permanent magnet group has third magnets 5a and 5c arrayed such that their polarization directions are periodically opposite, and fourth magnets 5b and 5d arrayed adjacent to the third magnets 5a and 5c such that their polarization directions are periodically opposite. --

Please substitute the paragraph beginning at page 10, line 1, with the following.

-- When a current is supplied to the two-phase coils, that is, the first and second coils, simultaneously, the total thrust is:

$$F = F1 + F2$$

$$= K \cdot B(I1 \cdot \sin(2\pi/a) + (I2 \cdot \cos(2\pi x/a))\underline{.}$$ --

Please substitute the paragraph beginning at page 11, line 14, with the following.

-- Since the coils opposing the permanent magnets 1a to 1d are the electromagnetic coils 2a and 2b, the thrust is:

$$F = 2 \cdot K \cdot B \cdot I\underline{.}$$ --

Please substitute the paragraph beginning at page 11, line 24, and ending on page 12, line 1, with the following.

-- In this manner, when a current is supplied to multi-phase coils placed in a sine wave magnetic field or <u>an</u> approximately sine wave magnetic field, the thrust becomes constant or almost constant, so an excellent linear motor with a small thrust ripple can be obtained. --

Please substitute the paragraph beginning at page 13, line 21, and ending on page 14, line 9, with the following.

-- Fig. 7 shows the second modification. Three permanent magnets 1f to 1h located at the terminal end side have smaller sizes in the x-axis direction and smaller volumes than those of the remaining permanent magnets 1a to 1d. [when] When the sizes in the x-axis direction of the permanent magnets 1f to 1h at the terminal end are gradually decreased, i.e., 15 mm for the permanent magnet 1f, 10 mm for the permanent magnet 1g, and 5 mm for the permanent magnet 1h, the y component of the magnetic flux density generated by this permanent magnet group becomes very close to a sine wave. For example, even at the terminal end of the linear motor movable element 10, the error with respect to the ideal sine wave can be decreased to be as [very] small as 2% or less of the amplitude of the sine wave. --

Please substitute the paragraph beginning at page 14, line 25, and ending on page 15, line 15, with the following.

-- Fig. 9 shows a semiconductor device manufacturing exposure apparatus having, as a wafer stage, a stage apparatus in which a linear motor M1 identical to that described above is used as the driving unit. A guide 52 and linear motor stator 21 are fixed on a surface plate 51. The linear motor stator 21 has multi-phase electromagnetic coils, and a linear motor movable element 11 has a permanent magnet group, in the same manner as described above. The linear motor movable element 11 is connected as a movable portion 53 to a movable guide 54 serving as a stage. When the linear motor M1 is driven, the movable guide 54 is moved in a direction normal to the surface of the sheet of the drawing. The movable portion 53 is supported by a

static pressure bearing 55 with reference to the upper surface of the surface plate 51 and by a static pressure bearing 56 with reference to the side surface of the guide 52. --

Please substitute the paragraph beginning at page 16, line 3, with the following.

-- An embodiment of a device manufacturing method conducted by the above exposure apparatus will be described. Fig. 10 shows the flow of the manufacture of a semiconductor device (e.g., a semiconductor chip such as an IC or LSI, a liquid crystal panel, a CCD, or the like). In step 1 (design circuit), a semiconductor device circuit is designed. In step 2 (fabricate mask), a mask as the master with the designed circuit pattern is fabricated. In step 3 (manufacture wafer), a wafer is manufactured by using a material such as silicon. In step 4 (wafer process) called a pre-process, an actual circuit is formed on the wafer in accordance with lithography techniques using the exposure apparatus by using the prepared mask and wafer. Step 5 (assembly) called a post-process is the step of forming a semiconductor chip by using the wafer fabricated in step 4, and includes an assembly process (dicing and bonding) and a packaging process (chip encapsulation). In step 6 (inspection), inspections such as the operation confirmation test and durability test of the semiconductor device fabricated in step 5 are conducted. After these steps, the semiconductor device is completed and shipped (step 7). --